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TITLED: CONSTANT COVERAGE WAVEGUIDE

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APPEAL BRIEF

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I. REAL PARTY IN INTEREST

The real party in interest is the assignee, Harman International Industries, Incorporated ("Applicant"), the Assignment of which was recorded on April 30, 2002 under Reel/Frame No. 012864/0020.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, judicial proceedings or interferences know to the Applicant that may be related to, directly effect or be directly effected by or have a bearing on the Board of Patent Appeals and Interference's decision in the pending appeal.

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III. STATUS OF CLAIMS

This is an Appeal from the June 2, 2006 Final Office Action, in which each of the pending claims 1-8 and 11-28 were rejected.

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IV. STATUS OF AMENDMENTS

No amendments have been filed subsequent to the mailing of the Final Office Action.

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V. SUMMARY OF CLAIMED SUBJECT MATTER

Loudspeaker horns have a small end called a "throat," a larger end called a "mouth," and a portion between the ends through which sound travels. The mouth is larger than the throat, typically having a cross-sectional area large enough to radiate sound and to reduce sound distortion. The portion between the throat and mouth includes an inner surface, referred to as an "acoustic waveguide," that constrains and controls the radiation of acoustic energy towards the mouth.

The sound driving unit couples acoustic energy to the throat at high pressure. The wave front of the acoustic energy radiating into the throat is nominally flat and free of curvature. The wave front expands as it travels outward to the mouth increasing in area in a manner controlled by the shape of the inner surface of the waveguide. Acoustic waveguides are typically designed so as to control the expansion of the area of the wave front so that the sound propagates according to a coverage pattern that remains consistent throughout a wide frequency range. Such an acoustic waveguide is said to have "constant directivity" or "constant coverage." Loudspeaker horns typically include diffraction geometry, such as diffraction slots at the throat, to provide sufficient control of the wave front propagation to achieve constant directivity.

Examples of the claimed subject matter include an acoustic waveguide that enables a wave front to expand smoothly and remain "attached" to the sidewall of the acoustic waveguide without geometric diffraction to produce constant directivity or constant coverage. In one example of an implementation, as illustrated in FIGURE A below, an acoustic waveguide **100** is provided that includes an inner surface defined by an upper vertical control curve **106**, a lower vertical control curve **108**, a right horizontal control curve **110**, and a left horizontal control curve **112**. The control curves extend continuously from a circular throat end **102** to a closed control curve that forms the mouth **104**. The right horizontal control curve **110** and a left horizontal control curve **112** lie in a horizontal plane mirrored about an imaginary center line **114** that extends axially through the waveguide **100**. Similarly, the upper vertical control curve **106** and the lower vertical control curve **108** lie in a vertical plane also mirrored about the imaginary center

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line **114**. The control curves that define the inner surface are mathematically continuous curves that include, but are not limited to, convergent-divergent, rational B-spline, parabolic, hyperbolic, ellipsoidal, linear, or exponential curves.

The upper vertical control curve **106**, lower vertical control curve **106,** right horizontal control curve **110**, and left horizontal control curve **112** are two dimensional curves that, together with the mouth and throat, define the inner surface of the acoustic waveguide **100**. The inner surface is continuous, three dimensional and optimally free of any mathematical discontinuities that may appear as edges, protrusions or steps.

The inner surface is also a least–energy-surface extending between the throat **102** and the mouth **104**. A least-energy-surface is a surface that passes through the specified controlling geometry in a manner that provides the minimum change in curvature when the rate of change of local curvature change is integrated in the mathematical sense of the entire surface. The least-energy-surface allows the area of narrowest width or height to pass through the continuous, three-dimensional curved surface so that the wave front expands smoothly and remains attached to the side wall of the waveguide **100**. The least-energy-surface allows for constant coverage and constant directivity without the need for any geometric diffraction for them or by diffraction slots or dispersion ellipse that would be formed at the mouth.

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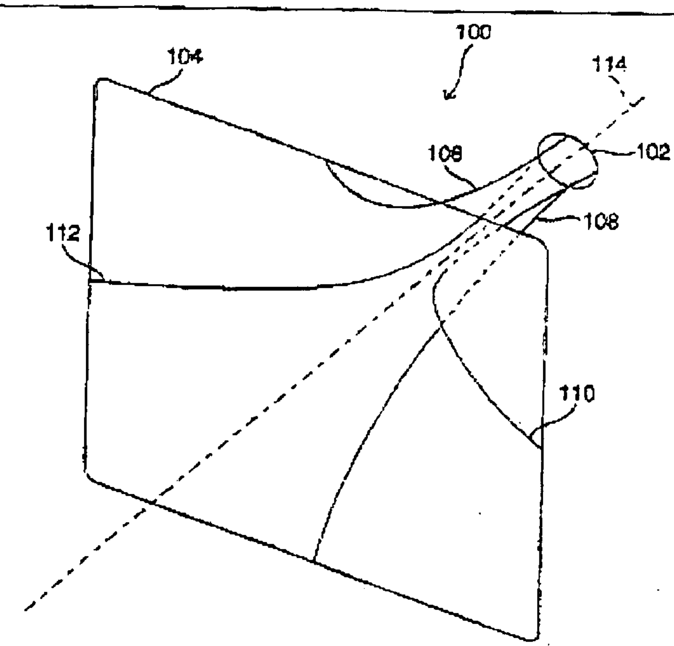

FIG. 1

FIGURE A

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL.

The rejection of claims 1-8 & 11-28 under 35 U.S.C. § 102(a) over Klayman, U.S. Patent No. 3,930,561, which is dated January 6, 1976, and titled *Low Distortion Pyramidal Dispersion Speaker* (hereinafter "Klayman") are to be reviewed on appeal.

VII. ARGUMENT

Claims 1-8 and 11-28 are not anticipated by Klayman because Klayman fails to teach or suggest each and every element recited in each pending claim. "A claim is anticipated only if each and every element as set forth in the claims is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d. 628, 631 (Fed. Cir. 1987). Applicant respectfully submits that Klayman fails to teach or suggest an acoustic waveguide having a "continuous three-dimensional least-energy-surface coincident with the control curves that intersect a circular throat and non elliptical closed control surface that defines a mouth."

Independent claim 1, recites "a continuous three-dimensional least-energy-surface coincident with the first control curve, second control curve, third control curve and the fourth control curve that intersects the circular throat and a non elliptical closed controlled surface that defines a mouth." Independent claim 7 is a method claim that recites the step of "generating a least-energy-surface that is formed from the first controlled curve, second control curve, third control curve and fourth control curve and intersect the circular throat and the non elliptical closed control curve forming at the mouth." Independent claims 12, 13, and 14 are apparatus claims that also recite a continuous three-dimensional least-energy-surface coincident with the control curves that intersect the circular throat and non elliptical closed control surface that defines a mouth; but with added limitations.

Accordingly, the analysis below focuses on showing that Klayman fails to teach a surface that is 1) continuous, and is 2) a least-energy-surface, where the surface is coincident with control curves that intersect a throat and a mouth. Because these limitation are not disclosed or suggested in Klayman, independent claims 1, 7, 12, 13, and 14 are not anticipated by Klayman and are therefore patentable under 35 U.S.C § 102(a).

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A. The *Klayman* Reference

FIGURE B shows the Klayman sectioned horn as illustrated on the cover sheet of the Klayman reference.[1] Klayman teaches using a sectioned horn with a pyramid-shaped section near the mouth of the horn to provide even dispersion at the horizontal and vertical planes. *See Klayman* 1:36-44. The pyramidal-shaped section is coupled to a conical section, which is further coupled to the sound transducer. *See Klayman* 1:28-44.

In the background section of the patent, Klayman notes that conical horns such as mega phones have minimal sound distortion but are otherwise very inefficient. *See Klayman* 1:10-12. Exponential horns on the other hand are highly efficient, but tend to introduce greater amounts of distortion as the efficiency increases. *See Klayman* 1:12-15. Diffraction horns are able to diffract sound around the edge of the horn mouth. However, one problem with diffraction horns is that the dispersion of the sound is not even in both horizontal and vertical planes. *See Klayman* 1:18-22. The sound is generated in an uneven distribution, so that it may sound rich and loud directly in front of the horn, but not so rich and loud towards the sides of the horn.

Klayman's sectioned horn shown in FIGURE B addresses the above issues by dividing the horn into sections specifically designed to provide either gain or directivity such that their combination results in even and efficient dispersion of the sound. FIGURE B illustrates the sections, which include:

1. a mating section **12** coupled to a sound transducer; *See Klayman* 1:27-32.
2. a cone shaped driver coupling section **14**, which flares outwardly in a conical shape from the mating section 12 towards the horn mouth; *See Klayman* 1:27-34.
3. a sound-to-air coupling section **20**, which is secured to the outer end 18 of the cone shaped driver coupling section **14**; *See Klayman* 1:44-46; and
4. a raised dispersion lip **26** around the outer periphery of the horn mouth to diffract sound symmetrically. *See Klayman* 1:59-62.

[1] The drawing on the cover sheet is Figure 3 of the Klayman reference.

Klayman describes each of these sections as performing a function. For example, the mating section **12** couples the sound from the sound transducer to the cone-shaped driver coupling section **14**. The cone shaped driver coupling section **14** couples the sound to the sound-to-air coupling section **20** with minimal distortion, and without sacrificing efficiency. The sound to air coupling section **20** is shaped to flair out at an exponential rate to form a square cross sectioned horn mouth giving the section its pyramidal shape. The shape of the sound-to-air coupling section **20** makes the horn efficient and able to generate sound with a suitable gain. The square cross-section at the mouth helps provide symmetrical sound dispersion. The raised dispersion lip **26** at the outer periphery at the square-cross sectioned mouth is particularly designed to provide symmetrical sound dispersion.

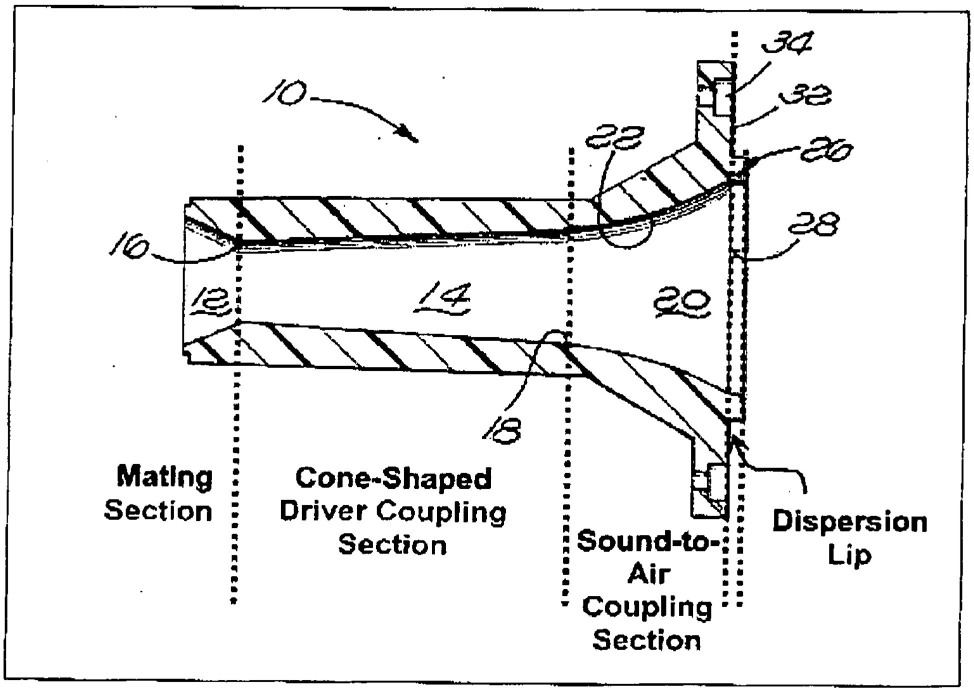

FIGURE B

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B. The Examiner has failed to make a prima facie case of anticipation.

In rejecting claim 1, the Examiner failed to show how Klayman teaches or discloses each and every element of claim 1. In the June 2, 2006 Final Office Action, the Examiner's entire reasoning for finding claim 1 anticipated by Klayman was set forth in the following passage:

> Klayman teaches an acoustic waveguide, comprising: a first control curve; a second control curve; a third control curve; a fourth control curve; and a continuous three-dimensional least-energy-surface coincident with the first control curve, the second control curve, the third control curve and the fourth control curve that intersect a circular throat end and a non-elliptical closed control curve that defines a mouth (fig. 1; col. 2 line 59 through col. 3 line 24).

See June 2, 2006 Final Office Action, pg. 2. This is a mere recitation of the claim language with citations to where, in Klayman, the elements of claim 1 are allegedly taught or suggested. However, Klayman clearly fails to teach or disclose any control curves, or that the inner surface of the horn is continuous, or that it is a least-energy-surface coincident with the control curves.

Referring to the cited passages, the Examiner cannot point to any support for arguing that Klayman discloses the subject matter in claim 1. The Examiner cited to Figure 1, which is set forth below as FIGURE C; and to col. 2, line 59 through col. 3, line 24. Figure 1 is a front view of the Klayman horn in through the mouth of the horn. The elements described with reference to Figure 1 are:

1. An integrally molded unit **10**;
2. The radius at the center line **22** of the exponential section walls;
3. The radius at each corner **24** of the exponential section walls;
4. A raised dispersion lip **26**;
5. Inner walls **28** of the raised dispersion lip;
6. Top walls **30** of the raised dispersion lip;
7. A flange **32** formed integrally around the outer end of the exponential section; and
8. Holes **34** for receiving screws, bolts or the like.

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None of these elements are control curves, nor are they any structure that suggest to one of ordinary skill in the art that that the inner surface is continuous and a least-energy-surface from the throat to the mouth of the horn.

The cited portion of the specification also fails to teach or suggest the missing claim limitations from claim 1. The cited portion at col. 2, lines 59-68 describes aspects of the horn mouth and the geometry of the exponential section **20**. "The horn mouth has a square cross-section in order to provide symmetrical sound dispersion, thus requiring the cross-section of the exponential section to also be approximately square throughout." The specification further states that element **22** is a radius that runs along the center line between the corners of the square cross-section extending through the exponential section **20** (*i.e.* sound-to-air coupling section **20**). Element **24** is a radius along the corner of the square cross-section extending through the exponential section **20**. The specification also states in this cited portion that the radius at each corner **24** of the exponential section **20** must be less than the radius along the center line **22** of the exponential section **20**.[2] It is important to note that the portion of the specification at col. 2, lines 59-68 is limited exclusively to describing the exponential section **20**. Nothing in this portion applies to any part of the horn that is between the exponential section **20** and the throat (*i.e.* the mating section **12**).

The remainder of the portion of the specification cited by the Examiner in support of a finding of anticipation (col. 3, lines 1-24) describes the raised dispersion lip at the outer periphery of the exponential section **20**. The raised dispersion lip "provides a sound diffraction corner for the horn mouth." The Examiner fails to note that because of the least-energy-surface of the waveguide recited in claim 1, no sound diffracting structure is needed. Thus, Klayman specifically teaches away from the claimed waveguide. Klayman does state that "the dispersion lip may be unnecessary given the proper flare of the exponential section." However, Klayman provides no guidance as to what constitutes a "proper flare." Moreover, it is the proper flare of the *exponential*

[2] It is noted that Klayman describes a physical impossibility. If the cross-section of the exponential section **20** is square, the radius at the corners (*i.e.* the line at **24** of Figure 1) <u>must</u> be greater than the radius at the center line between the corners (*i.e.* the line at **20** of Figure 1). *See* Figure C. Otherwise, the cross-section cannot be a square at any portion of the exponential section.

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section that is addressed by Klayman; and <u>not</u> the surface between the mouth and the throat of the horn.

The Examiner has failed to provide any analysis to show that Klayman teaches or suggests each and every element of claim 1. As discussed below, Klayman does not teach an acoustic waveguide having an inner surface that is either, (1) continuous between the throat and the mouth of the horn, or (2) a least-energy-surface that extends from the throat to the mouth.

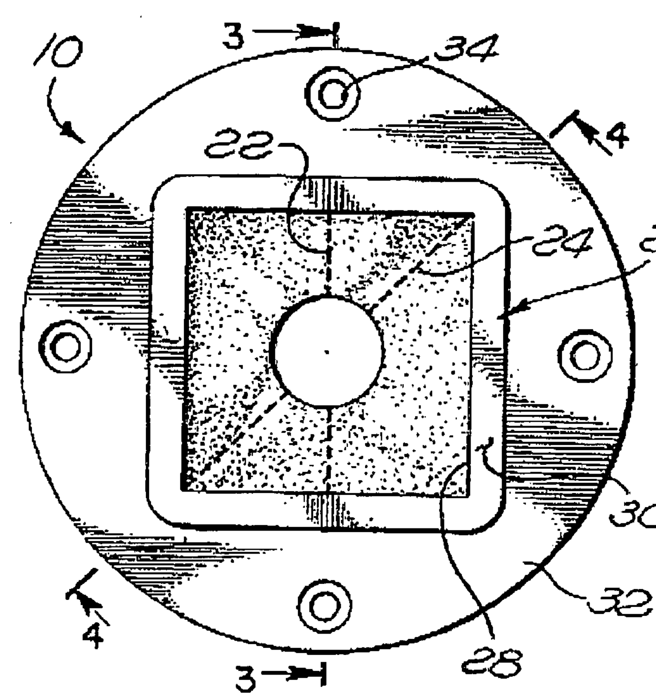

FIG. I.

FIGURE C

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C. Klayman does not teach or suggest "a continuous ... least-energy-surface coincident with ... control curve[s] that intersect a ... throat end and ... a mouth" as recited in independent claim 1.

1. Klayman does not teach an inner surface that is continuous between the throat and the mouth of the horn.

Klayman teaches a sectioned horn made up of four sections between the throat (where the sound transducer is located) and the mouth. The inner surface of the sectioned horn has discontinuities where each section connects to the next section. Referring to FIGURE B, there are discontinuities at:

1. Small end **16** of the cone-shaped driver coupling section **14**, where the cone-shaped driver coupling section **14** is coupled to the mating section **12**;
2. Large end **18** of the cone-shaped driver coupling section **14** where the cone-shaped driver coupling section **14** is coupled to the sound-to-air coupling section **20**; and
3. Outer periphery of the sound-to-air coupling section **20** where the dispersion lip **26** is formed.

Even one single discontinuity anywhere between the mating section **12** and the dispersion lip **26** is sufficient to preclude a finding of anticipation. Klayman has **three**.

In the May 1, 2006 Final Office Action Response, which was filed as a submission in a Request for Continued Examination, Applicants argued that Klayman did not teach a "least-energy-surface that is continuous, nor that is coincident with any control curves that intersect a circular throat and a non-elliptical closed control surface that defines a mouth." In the June 2, 2006 Final Office Action, the Examiner responded as follows:

> With respect to the Applicant's arguments that the Klayman patent fails to teach "a continuous ...least-energy-surface coincident with the first control curve, the second control curve, the third control curve and the fourth control curve." The examiner disagrees. As stated in the last office action (dated 1 November 2005), the Klayman reference teaches the radius at the midpoint of each side is 2.8 inches where as the radius as each corner is 1.7 inches

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> which suggests that the intersections of <u>least energy surface</u> of the Klayman reference are more inward relative to the sides, thus a smoothing effect at the corners. (emphasis in original)

Even if it were possible to implement the dimensional requirements that Klayman teaches (*see* Fn. 2), the portion of the specification recited by the Examiner refers exclusively to the exponential section **20** of the Klayman horn. *See infra.* Thus, the horn surface cannot be said to be coincident with control curves that intersect the throat and the mouth. Moreover, since the exponential section **20** is but one section of the Klayman horn, the surface of the horn cannot be said to be <u>continuous</u> between the throat and the mouth. The intersections between the other sections create discontinuities as shown in FIGURE B above.

Klayman does not anticipate claim 1 because Klayman does not teach an inner surface that is continuous between the throat and the mouth.

2. Klayman does not teach an inner surface that is a least-energy-surface extending between the throat and mouth of the horn.

Claim 1 recites a "least-energy-surface," which is a surface that allows the area of narrowest width or height to pass through the continuous, three-dimensional curved surface so that the wave front expands smoothly and remains attached to the side wall of the waveguide **100**. The least-energy-surface allows for constant coverage and constant directivity without the need for any geometric diffraction for them or by diffraction slots or dispersion ellipse that would be formed at the mouth. Claim 1 also recites that the least-energy-surface intersects the throat and the mouth.

Klayman teaches using a raised dispersion lip to provide sound diffraction. Klayman 3:1-24. The sound diffraction "provides a square edge to diffract sound in the shape of a broad-based pyramid around the horn mouth, thereby creating extremely wide sound dispersion in both the horizontal and vertical planes." *Klayman* 1:39-42. The need for a raised dispersion lip teaches away from a waveguide having an inner surface that is a least-energy-surface. Klayman also teaches a *sectioned* horn-a horn sectioned between

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the throat and the mouth, which teaches away from a surface that is a least-energy-surface intersecting the throat and the mouth.

In the June 2, 2006 Final Office Action, the Examiner responded to Applicants' argument that Klayman does not teach a least-energy-surface that intersects the throat and the mouth. The Examiner stated:

> Furthermore, the Applicant argues that the Klayman reference fails to teach *"the least energy surface intersects ...the throat and ... the mouth"*. The examiner disagrees. The Applicant's drawings show a complete structure, wherein the lines of the curves meet the throat and mouth sections, and the Klayman drawings show a complete structure, wherein the lines of the curves meet the throat and that mouth.

First, the Examiner is reading limitations into the specification by comparing the Klayman drawings with the drawings in Applicants' specification. Claim 1 recites that the least-energy-surface is coincident with the four control curves and intersect the throat and the mouth, which requires more than reference to continuous-looking curves in the drawings. In addition, the Examiner's reliance on the Klayman drawings to show "a complete structure, wherein the lines of the curves meet the throat and that mouth" (sic) flies in the face of the teaching of the specification.

The specification teaches a *sectioned* horn that includes discontinuities at the intersection of each section. *See Klayman* 1:29-45. Therefore, there are not curves extending from the throat to the mouth in the Klayman horn. There are only curves extending from the throat to the outer end of the conical section **18**, and a different curve extending from the outer end of the conical section **18** to the outer periphery of the sound-to-air coupling section **26**.

Klayman does not anticipate claim 1 because Klayman does not teach a least-energy-surface intersecting the throat and the mouth.

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VIII. CONCLUSION

In view of the above, claims 1-8, 11-28 are not anticipated by Klayman because Klayman fails to teach or disclose a constant coverage waveguide that includes a continuous three-dimensional least-energy-surface coincident with the control curves that intersect a circular throat and non elliptical closed control surface that defines a mouth as recited in independent claims 1, 7, 12, 13, and 14. Reversal of the final rejections of these claims and allowance of this patent application are earnestly solicited.

Applicant has enclosed with this Appeal Brief the required appeal fees and a request for a one month extension of time. The Commissioner is authorized to charge any additional fees that may be required, or credit any overpayment, to our Deposit Account No. 50-2542. A copy of this sheet is enclosed.

Respectfully submitted by,

Date: March 5, 2007

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IX. CLAIMS - APPENDIX

1. (Original) An acoustic waveguide, comprising:

   a first control curve;

   a second control curve;

   a third control curve;

   a fourth control curve; and

   a continuous three-dimensional least-energy-surface coincident with the first control curve, the second control curve, the third control curve and the fourth control curve that intersect a circular throat end and a non-elliptical closed control surface that defines a mouth.

2. (Original) The acoustic waveguide of claim 1, wherein the continuous three-dimensional least-energy-surface is free of discontinuities.

3. (Original) The acoustic waveguide of claim 1, wherein the continuous three-dimensional surface further includes: a minimum surface area axial section plane of the continuous three-dimensional surface formed from the first control curve, second control curve, third control curve, and fourth control curve.

4. (Original) The acoustic waveguide of claim 3, wherein the minimum surface area axial section plane is at the circular throat end of the acoustic waveguide.

5. (Original) The acoustic waveguide of claim 1, wherein the first control curve is symmetrical about an axis with the second control curve.

6. (Original) The acoustic waveguide of claim 5, wherein the third control curve is symmetrical about the axis with the fourth control curve.

7. (Original) A method for creation of an acoustic waveguide, comprising:

   identifying a first control curve;

   identifying a second control curve that mirrors the first control curve;

   identifying a third control curve;

   identifying a fourth control curve that mirrors the third control curve; and

   generating a least-energy-surface that is formed from the first control

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curve, second control curve, third control curve and fourth control curve and intersect a circular throat end and a non-elliptical closed control curve forming a mouth.

8. (Original) The method of claim 7, where generating further comprises forming the least-energy-surface as a continuous surface minimizing the formation of any discontinuities.

9.-10. (Canceled)

11. (Previously presented) The acoustic waveguide of claim 3, where the minimum surface area axial section plane is disposed at a midsection of the waveguide axially between the circular throat end and the non-elliptical closed control surface.

12. (Previously presented) An acoustic waveguide, comprising:

a first control curve;

a second control curve;

a third control curve;

a fourth control curve; and

a continuous three-dimensional least-energy-surface swept about a central axis of the waveguide with minimal discontinuities and coincident with the first control curve, the second control curve, the third control curve and the fourth control curve that intersect a circular throat end and a non-elliptical closed control surface that defines a mouth.

13. (Previously presented) An acoustic waveguide, comprising:

a first control curve;

a second control curve;

a third control curve;

a fourth control curve; and

a continuous three-dimensional least-energy-surface coincident with the first control curve, the second control curve, the third control curve and the fourth control curve that intersect a circular throat end and a non-elliptical closed control

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surface that defines a mouth, the least-energy-surface comprising a minimum surface area axial section plane formed from the first control curve, second control curve, third control curve, and fourth control curve, where the minimum surface area axial section plane is disposed at a midsection of the waveguide axially between the circular throat end and the non-elliptical closed control surface.

14. (Previously presented) An acoustic waveguide, comprising:

a first control curve;

a second control curve;

a third control curve;

a fourth control curve; and

a continuous three-dimensional least-energy-surface coincident with the first control curve, the second control curve, the third control curve and the fourth control curve that intersect a circular throat end and a non-elliptical closed control surface that defines a mouth, where each of the first, second, third and fourth control curves is convergent-divergent relative to an axial centerline of the waveguide.

15. (Previously presented) The acoustic waveguide of claim 12, wherein the continuous three-dimensional surface further includes a minimum surface area axial section plane of the continuous three-dimensional surface formed from the first control curve, second control curve, third control curve, and fourth control curve.

16. (Previously presented) The acoustic waveguide of claim 15, wherein the minimum surface area axial section plane is at the circular throat end of the acoustic waveguide.

17. (Previously presented) The acoustic waveguide of claim 15, where the minimum surface area axial section plane is disposed at a midsection of the waveguide axially between the circular throat end and the non-elliptical closed control surface.

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18. (Previously presented) The acoustic waveguide of claim 12, wherein the first control curve is symmetrical about an axis with the second control curve.

19. (Previously presented) The acoustic waveguide of claim 12, wherein the third control curve is symmetrical about the axis with the fourth control curve.

20. (Previously presented) The acoustic waveguide of claim 13, wherein the continuous three-dimensional least-energy-surface is free of discontinuities.

21. (Previously presented) The acoustic waveguide of claim 13, wherein the first control curve is symmetrical about an axis with the second control curve.

22. (Previously presented) The acoustic waveguide of claim 13, wherein the third control curve is symmetrical about the axis with the fourth control curve.

23. (Previously presented) The acoustic waveguide of claim 14, wherein the continuous three-dimensional least-energy-surface is free of discontinuities.

24. (Previously presented) The acoustic waveguide of claim 14, wherein the continuous three-dimensional surface further includes a minimum surface area axial section plane of the continuous three-dimensional surface formed from the first control curve, second control curve, third control curve, and fourth control curve.

25. (Previously presented) The acoustic waveguide of claim 23, wherein the minimum surface area axial section plane is at the circular throat end of the acoustic waveguide.

26. (Previously presented) The acoustic waveguide of claim 23, where the minimum surface area axial section plane is disposed at a midsection of the waveguide axially between the circular throat end and the non-elliptical closed control surface.

27. (Previously presented) The acoustic waveguide of claim 14, wherein the first control curve is symmetrical about an axis with the second control curve.

28. (Previously presented) The acoustic waveguide of claim 14, wherein the third control curve is symmetrical about the axis with the fourth control curve.

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X. EVIDENCE – APPENDIX

No Evidence Appendix is included.

XI. RELATED PROCEEDINGS – APPENDIX

None.